FWS National Wildlife Refuge System
Report on Wilderness Character Monitoring
Moosehorn National Wildlife Refuge

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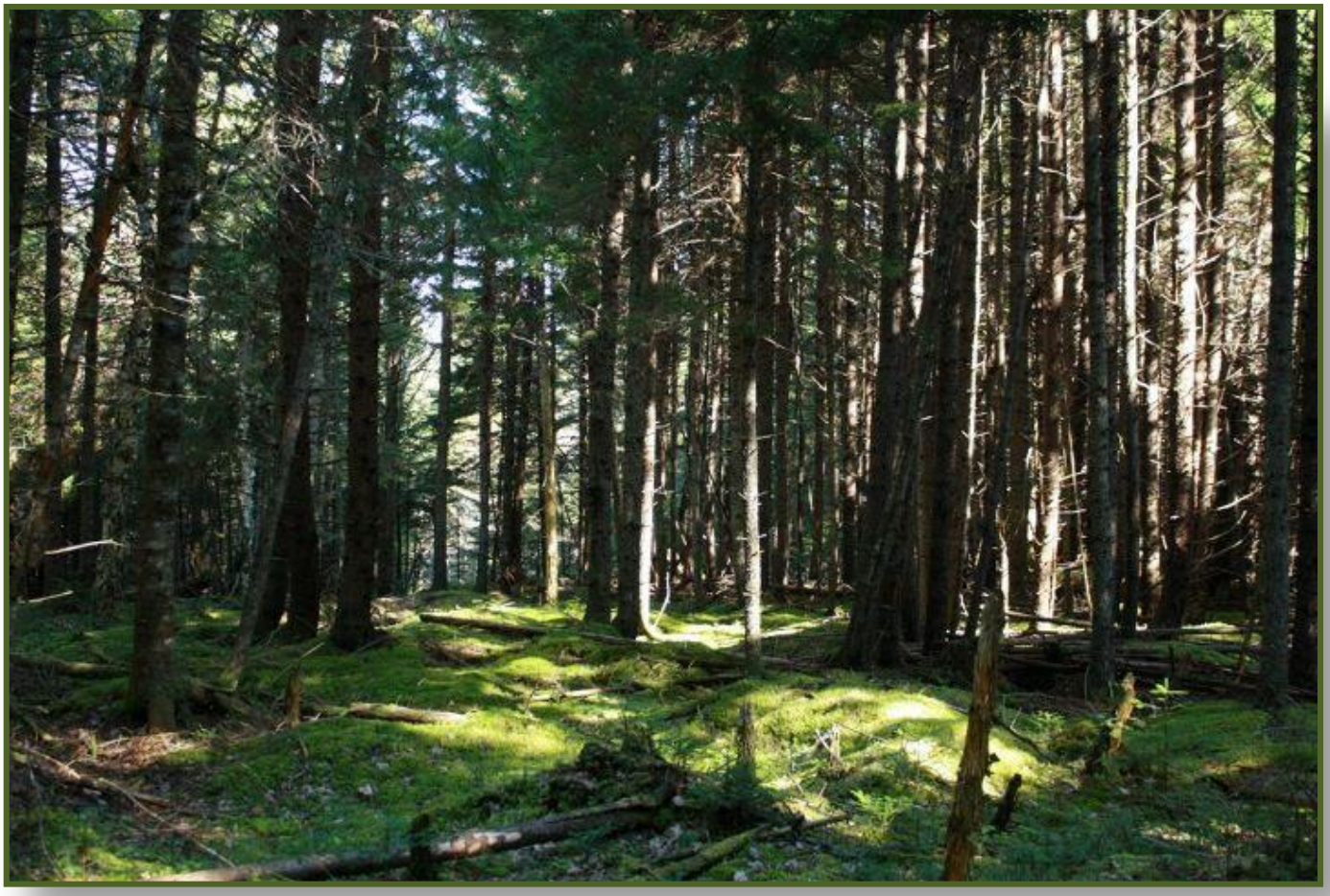

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EXECUTIVE SUMMARY

Moosehorn National Wildlife Refuge is a primarily upland, forested area with elevations ranging from about 50 feet to 480 feet above mean sea level. It is typically glaciated terrain comprised of diverse land features including ten natural lakes, numerous ericaceous bogs, beaver flowages, and streams interspersed throughout the mixed forest of conifers and hardwoods. Congress designated 2,782 acres of the Refuge on October 23, 1970 and 4,680 acres on January 3, 1975, as wilderness under the Wilderness Act of 1964, the highest level of protection afforded to federal land. These two divisions, Edmunds Division (including Birch Islands) and Baring Division are collectively known as Moosehorn NWR Wilderness. In order to preserve wilderness character and uphold the legislative mandate of the Wilderness Act, an evaluation of current conditions and a plan for monitoring long-term trends in wilderness are essential.

The approach provided therein follows wilderness character monitoring guidance developed by an interagency team, representing the U.S. Fish & Wildlife Service, National Park Service, U.S. Forest Service, and Bureau of Land Management. This national strategy is described in the 2008 "Keeping It Wild: An Interagency Strategy to Monitor Trends in Wilderness Character across the National Wilderness Preservation System" publication.

This document describes a wilderness character monitoring program for Moosehorn NWR Wilderness. Field surveys, refuge management policies, and documented uses are incorporated into this guide for managers and future monitoring efforts. Additionally, comments from Moosehorn NWR staff, other Fish & Wildlife Service staff, other federal agency staff, and personal accounts from residents of the area have been integrated, as appropriate, in this guide.

First, a brief background of Moosehorn NWR Wilderness and Refuge purposes is presented. Second, the process used to develop the monitoring framework is explained. Third, a suite of potential indicators and measures are proposed in order to conduct an initial wilderness character baseline assessment and subsequent monitoring. Fourth, a list of all measures ultimately not chosen for inclusion are discussed, along with concluding thoughts on the proposed monitoring program.

In effect, this document describes the wilderness character monitoring program for Moosehorn National Wildlife Refuge Wilderness.

BACKGROUND

Moosehorn National Wildlife Refuge (NWR) was established on January 13, 1937, when the first parcel of land was acquired for the refuge within the Baring Division, to protect habitat for American woodcock, waterfowl, and other migratory birds. The Baring Division was further expanded to include 16,000 acres by an Executive Order signed by Franklin D. Roosevelt on July 1, 1937. The Edmunds Division acquisition boundary of 10,800 acres was similarly established on August 30, 1938; not all land has yet been acquired. Due to several recent land acquisitions, the Baring Division includes 20,364 acres and the Edmunds Division includes 8,871 acres; collectively these Refuge lands total 29,235 acres. It is the only unit within the National Wildlife Refuge System that devotes a major portion of its management effort for research and demonstration of habitat management techniques that benefit American woodcock. This type of management also benefits a wide variety of migratory birds and resident wildlife including black ducks, neotropical migratory birds, ruffed grouse, and moose.

Moosehorn NWR lies within the farthest reaches of Downeast Maine, a region of rocky coastline, dense spruce-fir and northern hardwood forests, extensive beaver flowages, clear lakes and ponds, and meandering streams intermixed with blueberry barrens, cleared fields, and young forests. Along most of its eastern border, a narrow fringe of forest land lies between the Refuge and the Atlantic Ocean. To the north the Refuge abuts the St. Croix River and the United States-Canadian boundary, and on the west and south the area merges with the vast forest lands that blanket 85 percent of the State's 33,215 square miles of land area. Located in Washington County, the Refuge lies six miles south from Calais, Maine, and 100 miles east from the metropolitan area of Bangor, Maine.

Moosehorn NWR has 55 freshwater impoundments as recently as the 1990's, but only 38 are presently functional and are being actively managed. Many of these were likely once beaver flowages or small streams. Numerous dikes and water control structures were built in the 1950s to 1980's to benefit nesting and migratory waterfowl, particularly the American black duck. The Refuge has 18 miles of rocky shoreline along Denny's and Whiting Bays and 7 miles of shoreline on Meddybemps Lake. Portions of both Divisions are within the Denny's Bay Watershed; Denny's Bay is a high priority water body for Atlantic salmon recovery. Moosehorn is a breeding and migratory resting stop for many waterfowl, wading birds, shorebirds, and songbirds. Bald eagle and osprey nest on the Refuge.

Passamaquoddy Indians frequented the area on and around the Refuge in pursuit of food and fiber for their sustenance. In 1604, explorers Champlain and DeMonts established a colony on what is now St. Croix Island as the first settlement, though unsuccessful, of Europeans north of Florida. In 1779, the town of Calais itself was founded in the midst of a veritable wildlife paradise. The waters of the area that is now the Refuge afforded a plentiful supply of salmon, trout and other fish for the early settlers. Hunters had little trouble feeding their families with deer, caribou, moose, woodcock, ducks, geese, grouse, and other game which abounded throughout the area.

About this time, the tragic effect of overexploitation of nature's bountiful supply became evident. As with most early pioneers, Calais settlers were unable to envision an era when this "inexhaustible supply" would not exist. With the disappearance of the virgin forest and the

emergence of the steam engine, the sailing vessel shipbuilding industry came to a close in Washington County. By the 1920's, the periodic forest fires and overharvesting reduced wildlife and habitat to critical conditions. Caribou were extirpated from the area due to over-harvesting, with the last caribou being observed in 1908 in Maine.

Since the establishment of Moosehorn NWR, management practices have stimulated the return of fish and wildlife populations in balance with the habitat. Most of the Refuge supports second-growth timbered uplands interspersed with abandoned agricultural fields and pastures. In addition to the 3,586 acres of wetlands and 977 acres of open water, the Refuge also contains 234 acres of permanent grasslands, 184 acres of pastures, 86 acres of hayland, and 583 acres of permanent wildlife openings within the 24,672 acres of forests and brushlands.

Cobscook Bay State Park, an 868-acre area that is a part of the Edmunds Division was developed in 1963-64 under the Accelerated Public Works. The State Park operates on U.S. FWS lands under a 35-year lease. The park is a prominent attraction to the Calais area because of its beautiful secluded campsites on the rocky shores of Cobscook Bay. The U.S. FWS has a cooperative agreement with the Maine Bureau of Parks and Lands to directly manage the State Park area because of their expertise in managing campgrounds. There are plans to align the future management of Cobscook Bay State Park more closely with FWS management policies.

Establishing Moosehorn NWR Wilderness

With the passing of the Wilderness Act of 1964, Moosehorn NWR evaluated both divisions for potential wilderness designation (USFWS 1971, 1972). On October 23, 1970, Congress designated a 2,782-acre portion of the Edmunds Division and the Birch Islands (4 and 2 ½ acres in size, respectively) in Whiting Bay as wilderness. This was followed on January 3, 1975 with the designation of 4,680 acres on the Baring Division as wilderness (USFWS 1979). Collectively these areas are known as the Moosehorn NWR Wilderness with a total acreage of 7,462 acres.

Both mainland wilderness areas are primarily forested. The major forest types on the Baring Division Wilderness are aspen-birch woodland forest, red maple-pine forest, spruce-fir upland forest and flats, and white pine-hemlock forest. Approximately 681 acres of the Baring Division Wilderness are classified as wetlands, including six impoundments with water control structures that are no longer maintained. Two lakes are within the Baring Division Wilderness, 295-acre Bearce Lake and 34-acre Conic Lake, both shallow lakes that support warm water fisheries. Common loons also nest on both lakes. The State of Maine deeded all rights to Bearce, Cranberry, and Conic Lakes to the U.S. Fish and Wildlife Service in 1937. Maine generally claims ownership of all submerged lands (MRS Title 1 Chapter 1 § 3, Sovereignty and Jurisdiction, 2007).

The Baring Division Wilderness is bounded by interior refuge gravel service roads on the east and south, by State Route 191 on the west, and an electric power company right-of-way and other private lands to the north. In addition to the Bearce Lake vehicle access road, three other areas along Rt. 191 were excluded from the wilderness boundary for future development as trail heads and access points.

The primary forest type of the Edmunds Division Wilderness is spruce-fir upland forest and flats; the second most common forest type is aspen-birch woodland forest. Over 400 acres

have been classified as wetlands including the 110-acre Hobart Bog. Three impoundments which had dikes and water control structures are located within the Edmunds Division Wilderness. The dike and water control structures at Birch Flowage have washed out, and the stop logs on the Crane Mill Flowage (that lies down stream) are broken. The status of the concrete structure on Hobart Bog is unknown.

Hobart Stream forms the northern border of the Edmunds Division Wilderness; two smaller streams, Cranberry Brook and Crane Meadow Brook, tributaries of Hobart Stream, flow across the Edmunds Division Wilderness. Interior gravel refuge service roads that are open to the public most of the year form the eastern boundary, non-wilderness refuge lands form the southern boundary, and private forest lands, most of which have been harvested within the past 15-20 years, form the western boundary.

The Birch Islands lie about 0.3 miles off shore in Whiting Bay; they are only accessible by boat. The southernmost island has an active eagle nest on it which is usually successful. A 0.4-acre wildfire caused by an illegal campfire that was not properly extinguished occurred on the northern island on July 1999. Both islands are forested; primary tree species are white pine and white birch.

In 1947, the Society of American Foresters (SAF) organized a committee to consider the national need for a suite of "Natural Research Areas," in order to set-aside representative examples of each forest type in the U.S. The purpose of these areas is for science, research, and education. Three natural areas exist within the Moosehorn NWR Wilderness Area. A 160-acre natural area in the Baring Division, known as the Bertrand E. Smith Natural Area, was designated to preserve a representative sample of some of the best old growth white pine in the region. Two natural areas were designated inside the Edmunds Division: 10-acre Hobart Natural Area, one of the few pure stands of northern white cedar, and 40-acre Camp Two Natural Area, a dense stand of balsam fir.

In 1977, Congress acknowledged the uniqueness of Moosehorn NWR Wilderness by naming it as a Class I air quality area, providing special protection under the Clean Air Act. The U.S. Fish and Wildlife Service, as the Federal Land Manager has the responsibility to protect the air quality and air quality related values (AQRVs) of the area from manmade air pollution. AQRVs include vegetation, wildlife, soil, water quality, visibility, odor, and cultural and archaeological resources.

Air pollution from many sources, including pulp mills, power plants and automobiles, impact Moosehorn NWR. Haze from pollution reduces visibility in the Wilderness, and smoke plumes from nearby industry occasionally drift into the area. Moosehorn sometimes receives acid rain (and acid snow, fog, and dryfall), with a pH of roughly 4.6.

Refuge Purposes

The mission of the National Wildlife Refuge System is to *administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans* (Refuge Administration Act of 1966). The

landmark 1997 National Wildlife Refuge System Improvement Act, prepared the way for a renewed vision for the future of the refuge system where:

- Wildlife comes first;
- Refuges are anchors for biodiversity and ecosystem-level conservation;
- Lands and waters of the System are biologically healthy; and
- Refuges are national and international leaders in habitat management and wildlife conservation

The Refuge was established for the following:

> "…as a refuge and breeding ground for migratory birds and other wildlife…" –Executive Order 7650
>
> "…for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." – 16 U.S.C. 715d (Migratory Bird Conservation Act)
>
> "…suitable for – (1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered species or threatened species…" – 16 U.S.C. 460k-1 (Refuge Recreation Act)
>
> "…the conservation of the wetlands of the Nation in order to maintain the public benefits they provide and to help fulfill international obligations contained in various migratory bird treaties and conventions…" – 16 U.S.C. 3901(b), 100 Stat. 3583 (Emergency Wetlands Resources Act of 1986).
>
> "…shall be administered for the use and enjoyment of the American people in such manner as will leave them unimpaired for future use and enjoyment as wilderness, and so as to provide for the protection of these areas, the preservation of their wilderness character…" – 16 U.S.C. ¤ 1131 (Wilderness Act)

Several historical documents including articles in local and regional newspapers highlight the importance of the American woodcock in the establishment of the Refuge. In a letter to President Franklin D. Roosevelt, the Secretary of Agriculture described the importance of proposed Refuge lands and waters to wildlife as follows,

> "The wildlife population of this region is quite varied. There are numerous ruffed grouse, deer, bear, caribou, and moose, and during migration periods especially, an appreciable number of the more important species of waterfowl, all of which have in the past been hunted with little regard for law. *The protection of woodcock is however the paramount purpose for the establishment of the refuge.* These birds make this area their first landing point after crossing the Bay of Fundy during their southern migration from Nova Scotia and New Brunswick. …. Such concentration has, of course, been attractive to local sportsmen, and the woodcock naturally has suffered great loss in numbers. In the interest in wildlife preservation and in fairness to sportsmen to the southward dependent on this migration for their shooting, this concentration point should be set aside as a refuge."

Press Herald, Portland, Maine, May 3, 1938

"Biological Survey to Take Over Big Tract: Ten Thousand Acres At Baring Will Become Part Of Wild Life Sanctuary" " ... In connection with this use of the wooded area, the construction of artificial singing grounds for woodcock has already started, in attempt to conserve this type of Maine's wild life and to prevent its extinction." (A CCC camp of 200 men was established on the Refuge to help with wildlife management activities including building singing grounds).

Calais Advertiser, November 10, 1937
"Moosehorn Refuge Closed" "…While the refuge is primarily for the protection and propagation of woodcock, all forms of wildlife found on the area are protected and it is the intention of the Biological Survey to increase the usefulness of various types of vegetation to provide for the fullest possible use of the area for the wildlife."

RESOURCES AND PROCESS

This section provides detail on the resources and process utilized during the development of the suite of measures for wilderness character monitoring.

Documents Consulted

The following is a list of paper and electronic documents that I looked at to help identify measures to include for wilderness character monitoring at Moosehorn NWR:

- Comprehensive Conservation Plan DRAFT
- Background on Moosehorn Wilderness document
- Habitat Management Plan
- Wilderness Management Plan 1979

Staff Consulted

The following is a list of names and titles of the staff I spoke with to help identify measures:

Staff	Position Titles
Bill Kolodnicki	Refuge Manager
Maurice Mills	Wildlife Biologist
Ray Brown	Supervisory Biologist
Michael Heath	Forester
Amanda Hardaswick	Law Enforcement Officer
Steve Agius	Assistant Refuge Manager

Measure Selection Process

I arrived at Moosehorn NWR and immediately began reading the CCP and Wilderness Management Plan. The Refuge Wildlife Biologist had also created a document on the background of Moosehorn Wilderness. As I read through this information, I created an outline of questions, things that needed clarification/additional information, and potential measures.

I met with the Refuge Manager to gain more of a background on wilderness. I also went through my list to solicit clarification and/or information. In some instances, the Refuge Manager directed me to other Refuge staff that had more knowledge on specific topics. I met with the Wildlife Biologist with the same list and guided the conversation similarly. This gave me a better grasp on all the documents I read and more background.

Along with reading documents and meeting with staff, I also went hiking in wilderness (both divisions). This included solo hikes, as well as accompanied with the Forester. I became acquainted with some of the unique qualities of the wilderness. Later on, I also went on hikes accompanied by the American Hiking Society volunteers to different areas. All these experiences provided a first-hand relationship with the wilderness and bolstered my understanding of Moosehorn Wilderness.

I spent approximately 3 weeks developing a list of measures, as well as writing the WCM Final Report. I focused my efforts on providing essential information that would not only provide background on wilderness character monitoring but also the pertinent details of each measure. Initially, I only provided a draft for review to the Refuge Manager, Assistant Refuge Manager, and Wildlife Biologist. I met with both to go through the list of measures to get their feedback on each measure, the prioritization of measures, feasibility/relevance of measures, and also information on the data source/data collection process, etc. Both these conversations provided necessary information to incorporate into the final suite of measures and also to begin collecting data.

All this information helped to complete a first draft of the WCM Final Report. I provided copies to the Refuge Manager, Supervisory Biologist, and Forester for any comments/feedback. I did not share with the Wildlife Biologist at this time because I worked closely with him to gather the data. I thought it better use of his time to provide a final draft for review. I collected data and created an excel spreadsheet with all the final measures and pertinent information (including FY 2011 data). I used this spreadsheet to enter the measures and data into the WCM database application.

As the last step, I provided a final draft of the WCM Final Report and the excel spreadsheet of all the measures and FY 2011 data to the Refuge Manager and Wildlife Biologist for review. I created a folder with the WCM Final Report, FWS Wilderness Fellows- WCM Effort, Keeping Track of WCM Measures, spreadsheet of all the measures, and the WCM database application (complete with measures and data).

WILDERNESS CHARACTER MONITORING

The Wilderness Act (Section 7) requires the Secretaries of Agriculture and Interior to jointly report on the status of the National Wilderness Preservation System including descriptions of the areas, regulations in effect, and other pertinent information, together with any recommendations. This mandate necessitates individual wildernesses to monitor and assess wilderness character and report to the national level. With the aim to perform a proper assessment, baseline conditions must be set as a reference point against which change over time is measured and evaluated. Ideally, all baseline data would have been collected at time of designation. However, few existing wildernesses actually have this information. Therefore, data from the initial condition assessment may be substituted. In the case of Moosehorn NWR Wilderness, the initial condition assessment year is FY2011.

In order to identify trends in the wilderness resource, to evaluate the success of management strategies, and guide future strategies, a rigorous monitoring program for Moosehorn NWR

Wilderness is essential. The approach will follow the national strategy for wilderness character monitoring described in the "Keeping It Wild" publication.

Some recommendations in the monitoring program need to be adjusted for refuge-specific concerns, needs, and abilities. As the U.S. FWS Wilderness Fellow, I worked closely with Refuge staff to develop the following suite of potential measures for use in the Moosehorn NWR Wilderness.

Indicators and Measures

This monitoring program is based on hierarchically dividing wilderness character into successively finer elements (qualities of wilderness, monitoring questions, indicators, and measures). Data sources are identified for each measure.

1. Untrammeled Quality

According to the Wilderness Act of 1964, the "untrammeled" quality of wilderness is achieved "where man himself is a visitor who does not remain," and where an environment "generally appears to have been affected primarily by the forces of nature." This quality stresses a freedom from modern human control or manipulation and is compromised even when the wilderness is "manipulated" to sustain or improve another wilderness quality (such as the use of herbicides to rid the landscape of invasive weeds). Any human action that alters the wilderness is considered trammeling, which makes restraint a necessary tool in wilderness stewardship. In the words of Roderick Nash, author of *Wilderness and the American* Mind, "when we protect wilderness we deliberately withhold our power to change the landscape."

The purpose of monitoring the untrammeled quality is to track the intentionality of a decision to take an action rather than track the consequence of that decision. Under this quality, actions are the "unit of analysis" or the information that is recorded for assessing trends. An "action" is defined for this monitoring as an act or a series of acts that are purposefully taken to manipulate the biophysical environment. Furthermore, actions that manipulate the biophysical environment may be taken in the short-term and therefore degrade the untrammeled quality with the long-term future desire to improve another quality. For example, the treatment of invasive non-native plant species in the short-term degrades the untrammeled quality with the long-term future goal to improve the natural quality. The effect of the action will be accounted for under the natural quality.

Untrammeled Quality *Wilderness is essentially unhindered and free from modern human control or manipulation*				
Monitoring Question	**Indicator**	**Measure**	**Data Source**	**Freq (yr)**
What are the trends in actions that control or manipulate the "earth and its community of life" inside	Actions authorized by the FWS that manipulate the biophysical environment	1.1. Number of actions to manipulate plant, wildlife, insects, fish, pathogens, soil, water, or fires	Maurice Mills, Wildlife Biologist; Biological Science Technicians; Bill Kolodnicki, Refuge Manager	1
		1.2. Number of natural fire starts that received a suppression response within wilderness	John Meister, Fire Management Specialist	1

wilderness.		1-3. Number of lakes and other water bodies stocked with fish	Maurice Mills Wildlife Biologist	1
		[1-4] Number of person-hours maintaining trail	Bill Kolodnicki, Refuge Manager	1
		[1-5] Number of person-hours treating invasive plant species	Bill Kolodnicki, Refuge Manager	1
	Actions not authorized by the FWS that manipulate the biophysical environment	[1-6] Number of unauthorized actions by agencies, citizen groups, or individuals that manipulate plant, wildlife, insects, fish, pathogens, soil, water, or fire	Amanda Hardaswick, Law Enforcement Officer; Bill Kolodnicki, Refuge Manager	1

[Measure 1-1] Number of authorized actions to manipulate plant, wildlife, insects, fish, pathogens, soil, water, or fire

Context: This measure excludes actions related to any of the other measures under this indicator (i.e. treatment of invasive plant species). Action refers to an intentional decision to manipulate the biophysical environment. The focus is on agency actions that represent larger scale manipulations of populations, communities, and disturbance processes rather than smaller scale, localized manipulations. For example, the creation of vernal pool habitat would be counted as an action; removal of a single hazard tree would not be counted as an action. An action may be purposeful (i.e. resource protection) and management reasoning may be provided. The untrammeled quality is degraded if the number of authorized actions that manipulate the biophysical environment increases.

Relevance: This measure is relevant to the indicator because it monitors the large-scale or significant actions that manipulate the biophysical environment.

Data source(s): Refuge Manager; Refuge Biologist; Biological Science Technician(s).

Data collection process: Each separate action is counted and tallied annually. [Single action, single location = 1 action; Multiple action, single location = multiple actions; Multiple action, multiple locations = multiple actions; Action in one fiscal year = 1 action; Action in multiple fiscal years = multiple actions]

"Significant" change: Relatively little manipulation of the biophysical environment (excluding other measures under this indicator) occurs within wilderness. A 20% change is considered a "significant" change.

Data adequacy: The data adequacy is relatively high because any manipulations within wilderness are accounted for and actions are taken by the Refuge staff.

[Measure 1-2] Number of naturally ignited fire starts that received a suppression response within wilderness

Context: Natural fires are infrequent occurrences in the Wilderness Area, and also the larger landscape. There have been no documented fires within the Baring Division Wilderness. There have been two wildfires within the Edmunds Division in 1985 and 2001. Future changes in climate may alter fire frequency, intensity, and character. Only fires that were naturally ignited are included in this measure- fires that were human-caused are not included. A suppression response counts only if the action is taken within the Wilderness Area- it is not counted if it

occurs outside the boundary. The untrammeled quality is degraded by an increasing number of natural fire starts that are suppressed.
Relevance: As per the intention of the indicator, this measure captures authorized large-scale or significant actions that manipulate the fire within wilderness.
Data source(s): Fire Management Specialist
Data collection process: Count each number of naturally-ignited fires that received a suppression response within wilderness annually. If fire is suppressed outside of wilderness boundaries it is not counted since the suppression itself does not occur within the wilderness boundary.
"Significant" change: Any change is a "significant" change, since natural fire has not been a major ecological driver for the area.
Data adequacy: There is high data adequacy since all naturally ignited fires occurring within wilderness are recorded and reported to the Refuge.

[Measure 1-3] Number of lakes or other water bodies stocked with fish

Context: The State of Maine stocks Hobart Stream with Atlantic salmon (*Salmo salar*), a federally listed endangered species. Atlantic salmon is also an extirpated species in the area, specifically Hobart Stream. The State of Maine stocks Atlantic salmon outside of the wilderness boundary, which includes a segment of Hobart Stream. Since the stocking itself does not occur within wilderness, this is not counted under this measure. An increasing number of lakes or other water bodies that are stocked with fish degrade the untrammeled quality. Although fish stocking may have intentions to increase the natural quality, this measure focuses on tracking actions that manipulates fish populations and not the effects of fish stocking.
Relevance: As per the intention of the indicator, this measure captures authorized large-scale or significant actions that manipulate the fish within wilderness.
Data source(s): Biologist
Data collection process: Count the number of lakes or other water bodies within wilderness that are stocked with fish annually.
"Significant" change: Any change is significant change because there is no current fish stocking occurring within wilderness.
Data adequacy: Hobart Stream is the only known stream to be stocked with fish outside of wilderness that leads to stream segments within wilderness. There are other lakes and brooks within the wilderness that are not stocked. Data adequacy is relatively high since the refuge is knowledgeable and works in cooperation with the State of Maine.

[Measure 1-4] Number of person-hours spent maintaining trails

Context: Maintaining trails is one of the authorized manipulations occurring within wilderness that can easily be measured. Wilderness trails on the Refuge were largely neglected for many years until three years ago. Most of them have been completely impassible before the decision was made to minimally maintain the trails in order to provide access for wilderness users. Predominantly during the summer, the American Hiking Society, Youth Conservation Corps, and other volunteers maintain trails within wilderness using primitive tools (i.e. loppers, hand-saws). The maintenance of trails is done in order to provide opportunities for wilderness users to access the Wilderness Area. The untrammeled quality is degraded if person-hours spent maintaining trails increases.

Relevance: As per the intention of the indicator, this measure captures authorized large-scale or significant actions that manipulate the plants, as well as the larger biophysical environment, within wilderness.
Data source(s): Biologist; Refuge Manager
Data collection process: Trail maintenance is performed mainly by American Hiking Society volunteers; this usually occurs once a year for about a week. Person-hours are calculated by multiplying the number of people and number of hours.
"Significant" change: A 20% change is a significant change since there is not a large amount of trail maintenance occurring within wilderness at this point in time.
Data adequacy: This data is highly adequate because hours are usually recorded and/or there's a good knowledge of how many person-hours are spent maintaining trails.

[Measure 1-5] Number of person-hours treating invasive plant species
Context: Treating invasive plant species is one of the authorized manipulations occurring within wilderness that can easily be measured. During the summer, Student Conservation Association interns manipulate invasive plant species (i.e. removing, treating with herbicide, etc.) on a small-scale outside of wilderness areas. There may be a future need to do invasives-work within wilderness, although there is not a high presence of invasive non-native plant species within the Wilderness Area at this time. The untrammeled quality is degraded if the number of person-hours treating invasive plant species increases. This measure will show a degrading trend due to a purposeful decision to minimize the impacts of invasive plant species on non-invasive native plant communities.
Relevance: As per the intention of the indicator, this measure captures authorized large-scale or significant actions that manipulate the plants within wilderness.
Data source(s): Biologist; Refuge Manager
Data collection process: Majority of the treatment/removal of invasive plant species is done by Student Conservation Association interns; this usually occurs during the summer months. Person-hours are calculated by multiplying the number of people and number of hours spent treating and/or removing invasive plant species within wilderness.
"Significant" change: A 20% change is considered a significant change. There are not significant amounts of invasive plant species within wilderness, according to Refuge Biologist and Andy Cutko (Maine Natural Areas Program).
Data adequacy: This data is highly adequate because hours are usually recorded and/or there's a good knowledge of how many person-hours are spent maintaining trails.

[Measure 1-6] Number of unauthorized actions by agencies, citizen groups, or individuals that manipulate plant, wildlife, insects, fish, pathogens, soil, water, or fire
Context: Known unauthorized actions are limited within wilderness. This measure would allow flexibility to monitor any unauthorized actions as they may arise. This measure tracks unauthorized actions rather than violations because some actions may not be citable yet still be unauthorized actions that trammel the wilderness. The untrammeled quality is degraded if the number of unauthorized actions that manipulate the biophysical environment increases.
Relevance: This measure is relevant to the indicator because it tracks large-scale unauthorized actions manipulating the biophysical environment.
Data source(s): Law Enforcement Officer, Incident Reports and/or RAPP; Biologist

Data collection process: Each separate action is counted and tallied annually. Each separate action is counted and tallied annually. [Single action, single location = 1 action; Multiple action, single location = multiple actions; Multiple action, multiple locations = multiple actions; Action in one fiscal year = 1 action; Action in multiple fiscal years = multiple actions]. This includes unauthorized species takings, species releases, arson fire starts, and large-scale trash-dumping within wilderness. This does not include minor infractions such as littering, small-scale vandalism, or insignificant trespassing.
"Significant" change: Any change is a "significant" change because known unauthorized actions rarely occur inside wilderness. These are limited to unauthorized ATV use, which is rare since many of the areas are overgrown and do not provide easy access for such vehicles, or arson fire starts.
Data adequacy: This measure is based on the number of known incidences and therefore the level of effort used to collect this data would strongly influence the result; therefore the level of effort needs to be taken into account when interpreting the result. An increase in monitoring/enforcement presence on the Wilderness Area may result in higher detected unauthorized actions.

2. Natural Quality

Wilderness is required to remain "natural." The Wilderness Act states that wilderness should be "protected and managed so as to preserve its natural conditions." This quality calls for the protection of native species' communities and the structure and function of ecological systems within wilderness, and should be managed so they are substantially free from the effects of modern civilization.

While the untrammeled quality monitors the actions that manipulate or control wilderness ecological systems, the natural quality tracks the effects of these and other actions on the community of life in wilderness.

Natural Quality *Wilderness ecological systems are substantially free from the effects of modern civilization.*				
Monitoring Question	**Indicator**	**Measure**	**Data Source**	**Freq (yr)**
What are the trends in terrestrial, aquatic, and atmospheric natural resources inside wilderness?	Plants and wildlife species and communities	2-1. Number of native species that are listed as threatened and endangered, candidate, or of special concern	Andy Cutko, Maine Natural Areas Program; Maurice Mills, Wildlife Biologist	5
		2-2. Number of extirpated indigenous wildlife species	Maurice Mills, Wildlife Biologist	5
		2-3. Number of invasive non-native plant species	Andy Cutko, Maine Natural Areas Program; Maurice Mills, Wildlife Biologist	5

		2-4. Vernal pool habitat quality	Maurice Mills, Wildlife Biologist ; Coordinated by Northeast Region Amphibian Research and Monitoring Initiative (NEARMI)	1
	Physical resources	2-5. Visibility based on average deciview and sum of anthropogenic fine nitrate and sulfate	This will be monitored at the national level for all four federal land agencies	
		2-6. Ozone air pollution based on concentration of N100 episodic and W126 chronic ozone exposure affecting sensitive plants	This will be monitored at the national level for all four federal land agencies	
		2-7. Acid deposition based on concentration of sulfur and nitrogen in wet deposition	This will be monitored at the national level for all four federal land agencies	
	Biophysical processes	2-8. Departure from natural fire regimes average over the wilderness	Rick Vollick, Regional Fire Planner; John Meister, Fire Management Specialist	5
		2-9. Area and magnitude for pathways for movement of non-native species into the wilderness	GIS	5

[Measure 2-1] Number of native wildlife species that are listed as threatened, endangered, candidate, or of special concern

Context: The Wilderness Area may serve as a place where populations of sensitive plant and wildlife species can find some measure of protection. A decrease in this value over time could be caused by actions not under the control of a wilderness manager, but are impacts to naturalness nonetheless.

Relevance: This measure is relevant to the indicator because it tracks the number of sensitive wildlife and plant species.

Data source(s): Maine Endangered and Threatened Fish and Wildlife Species List by the Department of Inland Fisheries and Wildlife; Maine's List of Endangered and Threatened Species (2007); Species Reports- Environmental Conservation Online System by the U.S. Fish and Wildlife Service; and Refuge Biologists and Andy Cutko (Maine Natural Areas Program) determined which plant species were relevant for Moosehorn Wilderness.

Data collection process: Researched the website resources listed above and confirmed with Refuge Biologists for their professional knowledge of listed species for Wilderness Area. Each species is assigned a score according to its significance (i.e. Endangered = 4, Threatened = 3, Candidate = 2, and Special Concern = 1). Calculate the sum of all the scores. If the value of this measure changes, the local manager and resource specialist together will need to interpret if the change degrades or improves the natural quality.

"Significant" change: Any change is a significant change.

Data adequacy: The statuses of these species are based on the above listed resources as well as Refuge Biologists. The presence of listed species in the Wilderness Area is based on the professional knowledge of Refuge Biologists. Data adequacy is relatively high.

[Measure 2-2] Number of extirpated indigenous wildlife species

Context: This measure assesses trend based on the known history of an area from the time of European contact to the present day. If wildlife species were extirpated before wilderness designation and later restored to a wilderness, this would be an improvement in the natural quality. The natural quality is degraded if the number of extirpated indigenous species increases. Since data on plant species is lacking, this measure will focus on indigenous wildlife species.

Relevance: This measure is relevant to the indicator because it monitors the loss or extirpation of indigenous wildlife species from a wilderness.

Data source(s): The Mammals of the Eastern United States (Whitaker and Hamilton); USGS Maine Cooperative Wildlife Unit (Bill Krohn).

Data collection process: Each extirpated indigenous species is counted once annually.

"Significant" change: Any change in the number of extirpated indigenous species is considered a significant change because extirpation occurs over a long period of time and signifies a loss of viable species. Furthermore, a return of an extirpated species is considered a significant change and occurs over a potentially long period of time.

Data adequacy: Relatively high data adequacy; based on historical knowledge of indigenous species in the area.

[Measure 2-3] Number of invasive non-native plant species

Context: Invasive non-native plant species are not highly prevalent in the Wilderness Area and the Refuge in general. The Maine Natural Areas Program surveyed the Wilderness Area to identify any rare and sensitive plant species, along with invasive non-native plant species. This information was used in conjunction with Refuge knowledge regarding invasive non-native plant species.

Relevance: This measure is relevant to the indicator because it monitors selected invasive and non-native plant species that impact the natural quality of wilderness.

Data source(s): Andy Cutko, Maine Natural Areas Program; Maurice Mills, Refuge Wildlife Biologist; Ray Brown, Supervisory Wildlife Biologist

Data collection process: Each invasive non-native plant species is counted once annually. Consulted Refuge Wildlife Biologists, Refuge Manager, and Andy Cutko (Maine Natural Areas Program) regarding invasive non-native plant species. Invasive non-native wildlife species are not present on the Refuge, including wilderness.

"Significant" change: Since invasive non-native plant species are not a significant presence within wilderness at this time, any change is considered a significant change.

Data adequacy: The data is based on collective Refuge knowledge and information from Andy Cutko; data adequacy is relatively high.

[Measure 2-4] Vernal pool habitat quality

Context: Vernal pool habitat quality surveys have been conducted since 2005. These surveys look at the number of egg masses (or abundance) for blue-spotted salamander, wood frog, and fairy shrimp. These are indicator species for vernal pool habitats. Generally speaking, an

increase in the number of egg masses would be an increase in the vernal pool habitat quality and therefore increase the natural quality. Refuge Biologists should evaluate the data to decide the impact on the natural quality.
Relevance: This measure is relevant to the indicator because it tracks trends in the abundance of selected wildlife species that are of concern in vernal pool habitat environments.
Data source(s): Maurice Mills, Wildlife Biologist
Data collection process: Count the total number of egg masses for each indicator species found in vernal pool habitat within wilderness each year. This will provide information on the abundance of these indicator species and in effect the health and quality of vernal pool habitat.
"Significant" change: Any; since egg mass counts vary from year to year, depending on available water, weather, time of the survey, etc., Refuge Biologist must ascertain the significant change. Data is evaluated for a trend on 5+ years of data.
Data adequacy: Data adequacy is relatively high. Egg masses at each vernal pool are counted by two individuals for accuracy.

[Measure 2-5] Visibility based on average deciview and sum of anthropogenic fine nitrate and sulfate

Context: Deciview is a cumulative haziness index used to express light extinction. Basically, deciview is the visibility a wilderness visitor would experience. Fine nitrate and sulfate directly indicate degradation of visibility conditions. The natural quality is degraded if visibility declines.
Data source(s): Values for this measure will be gathered nationally for all four wilderness-managing agencies.

[Measure 2-6] Ozone air pollution based on concentration of N100 episodic and W126 chronic ozone exposure affecting sensitive plants

Context: Ozone and its precursor emissions (nitrogen oxides and volatile organic compounds) can travel long distances, resulting in elevated ozone levels in wilderness. Episodic ozone is the number of hours when the measured ozone concentration is greater than or equal to 100 parts per billion. Chronic ozone is the seasonal ozone exposure to vegetation over the entire growing season. The natural quality is degraded if ozone increases.
Data source(s): Values for this measure will be gathered nationally for all four wilderness-managing agencies.

[Measure 2-7] Acid deposition based on concentration of sulfur and nitrogen in wet deposition

Context: The concentration of sulfur and nitrogen in rain and snow is a major contributor to acid deposition, adversely affecting algae, aquatic invertebrates, amphibians, fish, soil microorganisms, plants, and trees. The natural quality is degraded if acid deposition increases.
Data source(s): Values for this measure will be gathered nationally for all four wilderness-managing agencies.

[Measure 2-8] Departure from natural fire regimes averaged over the wilderness

Context: Natural fires are infrequent occurrences in the Wilderness Area, and also the broader landscape. Natural fire has never been a major ecological driver in the development of northern forest ecosystems, in contrast to the pitch pine and oak-hickory forests of southern New England. Fire specialists in the region lack historical knowledge of the fire regimes and

therefore there is a lot of uncertainty. According to Rick Vollick (Regional Fire Planner) the rotation is long, given the infrequent occurrence (could be at least 300 to 1000+ years) for natural fire start. Almost all fires in New England are human caused, which is not a good basis for natural fire regime. A low or no departure from natural fire regimes increases the natural quality.

Relevance: This measure is relevant to the indicator because it tracks the alteration or disruption of natural biophysical processes inside wilderness, such as departure from natural fire regimes.

Data source(s): Rick Vollick, Regional Fire Planner, and John Meister, Fire Management Specialist

Data collection process: Conducted conversations with Rick Vollick and John Meister to get professional judgment to estimate the departure from natural fire regime of the Wilderness Area. A scale (No departure = 0, Low departure = 1, Moderate departure = 2, and High departure = 3) was used to gauge the level of departure from natural fire regime based on their professional judgment and knowledge of the area. There is a low to no departure from what is normal for spruce-fir forest found throughout Baring and Edmunds Divisions Wilderness areas. What would change this is any other disturbance adding additional surface fuel.

"Significant" change: There is insufficient historical knowledge and lack of agreement among fire specialists about the natural fire regimes in the New England region, except the pitch pine forest in Massachusetts. Any change is considered a significant change.

Data adequacy: This data is subjective since it is based on professional judgment and has a low-moderate level of adequacy.

[Measure 2-9] Area for pathways for movement of non-native species into the wilderness

Context: Trails and bodies of water that allow boat/kayak/canoe access pose potential opportunity for the introduction of non-indigenous species into wilderness. The only body of water considered for inclusion is Bearce Lake, since it is the only easily accessible area and frequented by non-local visitors. Other pathways are through non-local wildlife feces (i.e. horses, dogs), but were not considered here because they cannot be easily monitored.

Relevance: This measure is relevant to the indicator because it tracks the alteration or disruption of natural biophysical processes inside wilderness. Conditions outside the wilderness affect what is occurring inside and may foster movement of non-indigenous species to enter wilderness.

Data source(s): GIS data folder

Data collection process: Using data layers for wilderness trails and Bearce Lake, I created a ¼-mile buffer. The buffer was determined by a Refuge Wildlife Biologist as the area with the potential to introduce non-native species. The buffered area will be the area reported for this measure.

"Significant" change: A 20% change is considered a "significant" change because the creation of additional pathways will greater increase the likelihood to introduce non-native species, which can prove to be invasive as well. There is no current intent to create additional trails or make additional water bodies more accessible to the public.

Data adequacy: Data adequacy is relatively high; GIS analysis is used to obtain the data for this measure.

3. Undeveloped Quality

The Wilderness Act defines wilderness as an "area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation," and with "the imprint of man's work substantially unnoticeable." The Act further states "there shall be no temporary road, no use of motor vehicles, motorized equipment or motorboats, no landing of aircraft, no other form of mechanical transport, and no structure or installation." Any sign of modern human presence in the wilderness degrades the undeveloped quality.

Under this quality, non-recreational developments such as administrative sites, stock fencing, or fixed instrumentation sites are included. Cultural and heritage resources are considered a part of wilderness character. These resources are included under this quality because they primarily represent human relationships with the land prior to wilderness designation.

Undeveloped Quality *Wilderness retains its primeval character and influence, and is essentially without permanent improvement or modern human occupation.*				
Monitoring Question	**Indicator**	**Measure**	**Data Source(s)**	**Freq (yr)**
What are the trends in non-recreational development inside wilderness?	Non-recreational structures, installations, and developments	3-1. Number of authorized physical development	Maurice Mills, Refuge Wildlife Biologist; Bill Kolodnicki, Refuge Manager	5
		3-2. Number of culverts removed	Bill Kolodnicki, Refuge Manager	5
	Inholdings	3-3. Number of inholdings within wilderness	Bill Kolodnicki, Refuge Manager	5
What are the trends in mechanization inside wilderness?	Use of motor vehicles, motorized equipment, or mechanical transport	3-4. Type and amount of emergency use of motor vehicles, motorized equipment, or mechanical transport	Amanda Hardaswick, Law Enforcement Officer	1
		3-5. Type and amount of motor vehicle, motorized equipment, or mechanical transport use not authorized by Refuge manager	Amanda Hardaswick, Law Enforcement Officer	1
What are the trends in cultural resources inside wilderness?	Loss of statutorily protected cultural resources	3-6. Number and severity of disturbances to cultural resources	Bill Kolodnicki, Refuge Manager	5

[Measure 3-1] Number of authorized physical development

Context: All of the current physical developments have been there since before wilderness designation and are not currently maintained. This includes culverts and impoundment structures that have not been maintained, but also have not been removed. Removal of many of these structures may introduce more impact and intrusion on the Wilderness Area and therefore the Refuge has decided to leave many of these structures as they are. Some consideration for removal may be given to certain structures that are highly noticeable and/or

pose a threat on resources. The number of culverts is not included in this measure because not all have been documented, but the removal of any culverts will be documented in *Measure 3-2*. Developments primarily made for recreational purposes (i.e. trails) are tracked under the *outstanding opportunities for solitude or primitive and unconfined type of recreation* quality.
Relevance: This measure is relevant to the indicator because it tracks trends in the number and development level of structures, installations, or other developments inside wilderness that are primarily non-recreational.
Data source(s): Bill Kolodnicki, Refuge Manager; Maurice Mills, Refuge Wildlife Biologist
Data collection process: This measure is based on the collective knowledge of the Refuge Manager and Refuge Wildlife Biologist
"Significant" change: Any change is a significant change as the Refuge does not want to increase the amount of physical development within wilderness.
Data adequacy: Relatively high data adequacy on the physical developments known.

[Measure 3-2] Number of culverts removed from within wilderness
Context: There are numerous culverts within wilderness; the exact number is unknown at this time. Some of these culverts may be removed in the future if the Refuge deems it feasible and appropriate. This measure aims to capture the removal of these structures. An increase in this measure signifies an improvement to the undeveloped quality.
Relevance: This measure is relevant to the indicator because it tracks trends in the number of structures (i.e. culverts) inside wilderness that are primarily non-recreational.
Data source(s): Bill Kolodnicki, Refuge Manager
Data collection process: Count each culvert removed every 5 years.
"Significant" change: Any change is considered a significant change since it requires a formal decision, weighing the impacts to wilderness character against the benefits. Not all culverts will be removed since the impacts may be greater than the benefits.
Data adequacy: Data adequacy is relatively high since any removal will be approved and reported to the Refuge.

[Measure 3-3] Number of existing inholdings within wilderness
Context: There are currently no inholdings within wilderness but this measure is included due to potential to have inholdings with future land acquisitions. Also, it serves national reporting purposes.
Relevance: This measure is relevant to the indicator because it tracks trends in private properties immediately within wilderness.
Data source(s): Bill Kolodnicki, Refuge Manager
Data collection process: Count the number of inholdings within wilderness every 5 years.
"Significant" change: Any change is a significant change because inholdings have an impact on wilderness character and may exist for a long period of time. If there are additional inholdings the Refuge acquires through new land acquisition, this will have an impact.
Data adequacy: Data adequacy is high since these properties are documented.

[Measure 3-4] Type and amount of emergency use of motor vehicles, motorized equipment, or mechanical transport

Context: A "low" level of impact is typically a mechanized use that causes a small impact to the social environment and little to no impact on the biophysical environment (i.e., hand held motorized equipment, battery power tool, or wheelbarrow). A "moderate" level of impact is typically a mechanized use that causes a relatively moderate impact to the social environment (i.e., air compressor, generator, or portable pump). A "high" level of impact is typically a mechanized use that causes a large impact to the social environment and biophysical environment (i.e., helicopter, truck, or heavy equipment). The undeveloped quality is degraded if the type and amount of emergency use of mechanized use increased.
Relevance: This measure is relevant to the indicator (use of motor vehicles, motorized equipment, or mechanical transport) because it tracks the actual use of motor vehicles, motorized equipment, or mechanical transport for emergency uses.
Data source(s): Refuge Manager; Law Enforcement Officer
Data collection process: This measure is the sum of the number of pieces of motor vehicles, motorized equipment and mechanical transport authorized times the relative weighting times the number of days utilized for each piece of equipment during the emergency. For the purpose of this protocol, each day of one incident is counted separately.

Level of Impact	Weighting
Low	1
Moderate	2
High	3

"Significant" change: Any change is a significant change since the Wilderness Act prohibits the use of motor vehicles, motorized equipment, and mechanical transport.
Data adequacy: High data adequacy since all emergency use will be reported to the Refuge.

[Measure 3-5] Type and amount of motor vehicles, motorized equipment, or mechanical transport not authorized by Refuge manager.

Context: Due to the nature of these violations, it is unlikely that land managers could be more precise than the categories of frequency used here. The frequency scores are weighted to reflect the belief that violations by permittees or agency personnel are more akin to an authorized use and (theoretically, at least) more feasible to control. Weighting gives a greater incentive to control (or minimize) violations by permittees or agency personnel. The undeveloped quality is degraded if the type and amount of unauthorized mechanized use increased.
Relevance: This measure is relevant to the indicator (use of motor vehicles, motorized equipment, or mechanical transport) because it tracks the actual use of motor vehicles, motorized equipment, or mechanical transport for unauthorized uses.
Data source(s): Refuge Manager; Refuge Biologists; Law Enforcement Officer
Data collection process: The use of unauthorized equipment by each of the following categories of users is assigned a score, depending on its frequency of use multiplied by its areal extent. The scores of each type of user are summed to generate a total score reported for this measure.

Category	Frequency of unauthorized use	Score	Extent of unauthorized use	Score
Public	Common	3	Many locations	3

	Occasional	1	1 or 2 locations	1
	None	0	None	0
Permittees	Common	5	Many locations	3
	Occasional	3	1 or 2 locations	1
	None	0	None	0
Agencies	Common	5	Many locations	3
	Occasional	3	1 or 2 locations	1
	None	0	None	0

"Significant" change: Any change is a significant change since the Wilderness Act prohibits the use of motor vehicles, motorized equipment, and mechanical transport.
Data adequacy: Data adequacy is moderate since this is based on detected incidences, which depends heavily on Refuge staff and other individuals being present or knowledgeable of such use.

[Measure 3-6] Number of disturbances to cultural resources
Context: There are no known cultural resources within wilderness and therefore these resources are not disturbed. For national reporting purposes, this measure will be included.
Relevance: This measure is relevant to the indicator because it monitors evidence of disturbances or loss of cultural resources that are protected by law and agency policy.
Data source(s): This is based on professional and historical knowledge of the Refuge Manager.
Data collection process: Count the number of disturbances to cultural resources
"Significant" change: Any change is a significant change since there are no cultural resources.
Data adequacy: High data adequacy.

4. Opportunities for Solitude or Primitive and Unconfined Type of Recreation Quality

According to the Wilderness Act, wilderness has "outstanding opportunities for solitude or a primitive and unconfined type of recreation." This quality is about the *opportunity* for visitors to experience wilderness; it is not directly about visitor experience per se. Factors that reduce these opportunities, and therefore degrade this quality, include visitor encounters, signs of modern civilization, recreation facilities, and management restrictions on visitor behavior.

Recreation-focused developments such as trails, campsites, shelters, or toilets are included under the solitude or primitive and unconfined recreation quality because of the strong connection to recreational experiences. The distinction between non-recreational and recreation physical development is also made to avoid double-counting recreational developments under both qualities.

Solitude or Primitive and Unconfined Recreation *Wilderness provides outstanding opportunities for solitude or primitive and unconfined recreation.*			
Monitoring Question	**Indicator**	**Measure**	**Notes**
What are the trends for outstanding opportunities for solitude within wilderness?	Remoteness from sights and sounds of people inside the wilderness	4-1. Amount of visitor use	Bill Kolodnicki, Refuge Manager
		4-2. Number of trail contacts	Bill Kolodnicki, Refuge Manager
		4-3. Number and condition of campsites within wilderness	Bill Kolodnicki, Refuge Manager

		4-4. Area of wilderness affected by access or travel routes that are inside the wilderness	GIS
	Remoteness from occupied and modified areas outside the wilderness	4-5. Area of wilderness affected by access or travel routes that are adjacent to the wilderness	GIS
What are the trends in outstanding opportunities for primitive and unconfined recreation inside wilderness?	Facilities that decrease self-reliant recreation	4-6. Type and number of agency-provided recreation facilities	Bill Kolodnicki, Refuge Manager
		4-7. Miles of agency-provided system trails	GIS
	Management restrictions on visitor behavior	4-8. Number and extent of management restrictions	Refuge regulations

[Measure 4-1] Amount of visitor use

Context: There are sign-in sheets at South Trail in Edmunds Division Wilderness. There are trial counters but it does not give an accurate reading for this measure. Instead sign-in sheets and number of parked cars on a typical weekend are used to estimate amount of visitor use. This quality would be degraded if the amount of visitor use increase beyond a locally determined standard.

Relevance: This measure is relevant to the indicator because it tracks the amount of visitor use and therefore the amount of actual or potential recreation use that diminishes opportunities for solitude. A greater amount of use may cause more encounters among groups, in turn decreasing opportunities for solitude.

Data source(s): Refuge Manager; Sign-in sheets

Data collection process: Calculate the average number of people entering South Trail at Edmunds Division Wilderness by total number of people that signed the sheet divided by the total number of days the sheets were collected for. The average number of visitors/day multiplied by the number of days (May-October) will give an estimate of visitor use of South Trail in Edmunds. For Bearce Lake, estimate 5 cars (2 people) for a typical weekend times the number of weekends (May-October). Add both numbers for amount of visitor use.

"Significant" change: A 50% change is considered a significant change.

Data adequacy: The data is based on sign-in sheets and professional judgment.

[Measure 4-2] Number of trail contacts

Context: This measure focuses on contacts the recreation user has with other wilderness visitors as well as administrative staff along a trail where most encounters occur. This quality would be degraded if the number of trail contacts increases.

Relevance: This measure is relevant to the indicator because it tracks the amount of visitor use and therefore the amount of actual or potential recreation use that diminishes opportunities for solitude. A greater amount of use may cause more encounters among groups, in turn decreasing opportunities for solitude.

Data source(s): Refuge Manager

Data collection process: This has not yet been implemented within wilderness, but will be next year. Volunteers will hike wilderness trails and count the number of people they encounter (i.e. following the same protocol as with other trails on the refuge).
"Significant" change: This will be determined as data is collected.
Data adequacy: Data adequacy will be relatively moderate and depends largely on the collection frequency.

[Measure 4-3] Number and condition of campsites within wilderness

Context: There are no agency-provided campsites within wilderness at this time. There is a great potential to introduce campsites in the near future at the wilderness islands.
Relevance: This measure is relevant to the indicator because it tracks the amount of actual or potential recreation use that diminished opportunities for solitude.
Data source(s): Refuge Manager
Data collection process: The number of campsites will be reported to the Refuge Manager from the partnering volunteer group that will maintain and monitor these potential campsites.
"Significant" change: This will be determined once campsites are established.
Data adequacy: Data is adequate.

[Measure 4-4] Area of wilderness affected by access or travel routes that are inside the wilderness

Context: Access and travel routes within wilderness are predominantly system trails. This measure tracks the amount of area inside a wilderness that is influenced by the presence of access or travel routes. Since most wilderness visitors stay on or close to trails, this is a measure of the area frequented by visitors and is a coarse estimator of the area with reduced opportunities for those seeking solitude. This quality would be degraded if the area affected by travel routes increases.
Relevance: This measure is relevant to the indicator because it tracks the amount of actual or potential recreation use that diminishes opportunities for solitude within wilderness. This measure addresses the potential for a visitor to "get away" via access and travel routes.
Data source(s): GIS
Data collection process: Using GIS, a ¼-mile buffer around trails inside wilderness is used to calculate the total area of wilderness affected by access or travel routes.
"Significant" change: Any change is a significant change since trails are not altered very often.
Data adequacy: Data is based on the assumption that ¼-mile buffer adequately captures the potential impacted area of noise or presence of people on trails. This may vary in areas more densely forested compared to more open areas (i.e. wetlands, lakes). Additionally, some trail segments may be more frequented than others. For the purpose of this measure, all trails were treated equally.

[Measure 4-5] Area of wilderness affected by access or travel routes that are adjacent to the wilderness

Context: The Baring Division Wilderness is adjacent to Route 191, a paved main highway used by motor vehicles (including trucks). The Edmunds Division Wilderness does not immediately abut a major highway, but several gravel roads surround the area. This quality would be degraded if the area affected by travel routes increases.

Relevance: This measure is relevant to the indicator because it monitors selected conditions occurring on lands adjacent to the wilderness that affect visitors' opportunities for solitude. Even though managers may not be able to take action to mitigate or prevent some of these conditions, they nonetheless may diminish wilderness character.
Data source(s): GIS
Data collection process: GIS analysis will be used to compute the number of acres that are less than ¼ mile from any gravel or unpaved road outside the wilderness; ½ mile from any paved road (i.e. Route 1 and Route 191) outside the wilderness. This quality is degraded if the area affected by travel routes increases.
"Significant" change: Any change is a significant change because the Wilderness Area is relatively small and paved roads, including a main highway, introduce noise affecting a visitor's opportunity for solitude.
Data adequacy: Data adequacy is relatively high. Factors such as time of year (i.e. leaf-off seasons) and vehicle noise impact (i.e. truck versus car) are not included in the calculations because it would require of an effort to quantify those levels at this time.

[Measure 4-6] Type and number of agency-provided recreation facilities

Context: The Wilderness Area includes a boat launch and trail markers and signs. The trail markers are either wooden arrows or blue paint on the trees. The signs are also wooden. The refuge does not have an inventory of the total number of trail markers and signs, but the SCA trail crew had this data.
Relevance: This measure is relevant to the indicator because it monitors agency-provided recreation facilities that degrade the perceived opportunity for primitive and unconfined recreation.
Data source(s): Refuge Manager
Data collection process: This measure is based on knowledge of Refuge staff. When data is available from the SCA trail crew, the number of signs or any other recreation facilities will be included.
"Significant" change: Any change is a significant change since change is not frequent.
Data adequacy: Data adequacy is relatively high because the Refuge is knowledgeable of agency-provided recreation facilities.

[Measure 4-7] Miles of agency-provided system trails

Context: Before the designation of wilderness, old gravel roads intersected the area. These old road beds are not maintained as roads and are used as foot trails for wilderness users.
Relevance: This indicator is relevant to the indicator because it tracks trends in durable or permanent facilities that are used primarily for recreational purposes, regardless of whether these are for resource protection or visitor convenience. These facilities degrade the perceived opportunity for primitive and unconfined recreation.
Data source(s): GIS
Data collection process: Measure the miles of system trails within wilderness every 5 years.
"Significant" change: A change of 1 mile is considered a significant change, since the Wilderness Area is not a large land mass.
Data adequacy: High data adequacy.

[Measure 4-8] Number and extent of management restrictions

Context: These regulations are aligned with management policies and in most cases serve to protect the resources of the refuge, including the Wilderness Area. This quality degrades if the type and extent of management restrictions increases.
Relevance: This measure is relevant to the indicator (management restrictions on visitor behavior) because it monitors restrictions that FWS places on visitor behavior inside wilderness.
Data source(s): Refuge management policies
Data collection process: Each of the following types of regulations is assigned a score, depending on its degree of restriction. If a wilderness has more than one type of regulation within a given category, the score will be assigned that corresponds to the most restrictive regulation in place. Tally up the management restrictions and associated score for this measure.

Category	Type of Restriction	Score
Camping	No restriction	0
	Any mandatory check	1
	Designated sites	2
	Assigned sites	3
	Overnight use prohibited	4
Campfires	No regulation	0
	Designated site; seasonal restrictions; or prohibited above (or below) designated elevation; or a mandatory setback	1
	Total prohibition	2
Fees	No fees	0
	Fees charged of selected user type	1
	Fees charged of all visitors	2
Permits	No permit or registration	0
	Voluntary self-registration	1
	Mandatory, non-limiting permit or registration	2
	Mandatory, use limited	3
Length of stay	No restrictions on length of stay	0
	Length of stay limited	1
Stock use	No restrictions	0
	Grazing by stock prohibited	1
	No off-trail stock use	2
	No camping with stock	3
	Stock use prohibited	4
Human waste	No regulation	0
	Pack out required	3
Swimming/bathing	No restrictions	0
	Prohibited	2
Area closure	No restriction	0
	Area closed to use	5
Group size limits	No restriction	0
	Group size limits in place	1
Leash requirements	No restriction	0
	Dogs required to be on leash	1
	Dogs prohibited	2

"Significant" change: Any change is considered a significant change since regulations/restrictions are not changed often.
Data adequacy: Data adequacy is relatively high since all regulations/restrictions are implemented by the Refuge.

DROPPED MEASURES

The following are measures that were considered but ultimately dropped.

Dropped Measure	Reason why measure was dropped						
	Data not available/ quality of available data poor	Low relevance to assessing wilderness character	Insufficient development of measure	Low relevance to this wilderness	Not feasible for Refuge to monitor	Notes	Priority
Number of non-indigenous species	X				X		LOW
Number of acres of authorized active grazing allotments				X		This does not occur within Wilderness Area	LOW
Change in demography or composition of communities	X		X		X	Pilot project to research spruce grouse in 2011, but not enough data	MED
Breeding land bird surveys		X				Surveys look at managed versus unmanaged areas and land bird habitation; not relevant	LOW
Haziness over Baring Division Wilderness	X					Digital images displayed on website, but no real reportable data (i.e. number of high-level hazy days); only relevant to Baring Division Wilderness	MED
Extent and magnitude of change in water quality	X				X	There are no site-specific concerns to conduct water	LOW

Dropped Measure	Reason why measure was dropped						
	Data not available/ quality of available data poor	Low relevance to assessing wilderness character	Insufficient development of measure	Low relevance to this wilderness	Not feasible for Refuge to monitor	Notes	Priority
						quality monitoring (i.e. impacts from grazing or mining)	
Extent and magnitude of human-caused stream bank erosion	X				X		LOW
Extent and magnitude of disturbance or loss of soil or soil crusts				X	X		LOW
Extent and magnitude of global climate change			X			Potential to start a Budburst project, but dependent on funding	MED
Area and magnitude of loss of connectivity with the surrounding landscape				X			LOW
Index of unauthorized (user-created) physical development				X			LOW
Type and amount of administrative and non-emergency use of motor vehicles, motorized equipment, and mechanical transport				X			LOW
Night sky visibility	X					GoogleEarth Artifical Night Sky Brightness data layer does not have data on this area; possible to purchase a Sky	MEDI

Dropped Measure	Reason why measure was dropped						
	Data not available/ quality of available data poor	Low relevance to assessing wilderness character	Insufficient development of measure	Low relevance to this wilderness	Not feasible for Refuge to monitor	Notes	Priority
						Quality Meter	
Extent and magnitude of intrusions on natural soundscapes			X				MED
Type and number of user-created recreation facilities				X			LOW

CONCLUSION

The suite of measures adequately represents the wilderness character of Moosehorn NWR Wilderness. A total of 28 measures are incorporated into the monitoring protocol (Untrammeled quality = 6, Natural quality = 9, Undeveloped quality = 6, and Opportunities for Solitude or Primitive and Unconfined Recreation quality = 7). This is not an exhaustive list of measures, but the selected measures have been identified as strong measures that highlight the qualities germane to wilderness character. Additionally, these selected measures have been identified as priorities and feasible for Refuge staff to monitor over time. There are opportunities to incorporate other measures through relatively easy means (i.e. obtaining a Sky Quality Meter to measure night sky visibility) that the Refuge staff can consider.

From 1980 to 1982 the Maine Critical Areas Program conducted statewide inventories to identify and document old-growth forests. Old-growth forests maintain natural conditions and there is potential to utilize this as a measure to monitor the natural quality. A report of the findings was published in 1983 and identified one-acre of old-growth white pine are found within a mixed wood stand on the east side of Bald Mountain within the Baring Division Wilderness Area. An estimated 50 old-growth pines are found within a younger stand of red spruce, balsam fir, striped maple, and red maple. This remnant old-growth white pine stand meets the criteria for age, stand identity and naturalness. The Refuge sees a potential to further study the forest ecosystems within Wilderness, particularly due to the newly hired Forester. A measure was not included in the suite of measures discussed previously because it still requires development. The Refuge Forester can assist in developing an appropriate measure.

A wilderness review of the Refuge has identified potential land in the Edmunds Division and the islands, suitable for wilderness designation. The islands and currently wilderness designated Birch Islands are not frequented often and only accessible by boat. There are plans to allow campsites and overnight use in the near future on these islands. In order to capture this, the number and condition of campsites is included in the suite of measures. As of now, there are no campsites.

I anticipate that this wilderness character monitoring protocol will be easily implemented. All the measures require little to no additional refuge staff effort to collect the data. Majority of all the measures are already being collected or can easily be extrapolated from refuge-wide monitoring efforts.

APPENDIX A- *WORKSHEET: Prioritizing Measures of Wilderness Character*

In each row, write the indicator and potential measure in the left column. Use the following criteria and ranking guide to create an overall score for each measure. Those measures with the highest overall scores should be the highest priority for assessing trends in wilderness character.

A. Level of importance (the measure is highly relevant to the quality and indicator of wilderness character, and is highly useful for managing the wilderness): High = 3 points, Medium = 2 points, Low = 1 point

B. Level of vulnerability (measures an attribute of wilderness character that currently is at risk, or might likely be at risk over 10-15 years): High = 3 points, Medium = 2 points, Low = 1 point

C. Degree of reliability (the measure can be monitored accurately with a high degree of confidence, and would yield the same result if measured by different people at different times): High = 3 points, Medium = 2 points, Low = 1 point

D. Degree of reasonableness (the measure is related to an existing effort or could be monitored without significant additional effort): High = 1 point, Low = 0 point

STOP!

If A + B ≤ 2

UNTRAMMELED QUALITY: Criteria for Prioritizing Potential Measures						
Potential Measure	**A. Importance**	**B. Vulnerability**	**C. Reliability**	**D. Reasonableness**	**OVERALL SCORE**	**PRIORITY LEVEL**
Indicator: Actions authorized that manipulate the biophysical environment Measure: Number of actions to manipulate plants, animals, pathogens, soil, water, or fire	3	2	2	1	8	MEDIUM
Indicator: Actions authorized that manipulate the biophysical environment Measure: Percent of natural fire starts that received a suppression response	2	2	3	1	8	MEDIUM
Indicator: Actions authorized that manipulate the biophysical environment Measure: Number of lakes and other water bodies stocked with fish	2	2	3	1	8	MEDIUM

Indicator: Actions authorized that manipulate the biophysical environment Measure: Number of person-hours maintaining trail(s)	3	3	2	1	9	HIGH
Indicator: Actions authorized that manipulate the biophysical environment Measure: Number of person-hours treating invasive plant species	3	3	2	1	9	HIGH
Indicator: Actions unauthorized that manipulate the biophysical environment Measure: Number of unauthorized actions that manipulate plant, wildlife, insects, fish, pathogens, soil, water or fire	3	2	3	1	9	HIGH

NATURAL QUALITY: Criteria for Prioritizing Potential Measures						
Potential Measure	**A. Importance**	**B. Vulnerability**	**C. Reliability**	**D. Reasonableness**	**OVERALL SCORE**	**PRIORITY LEVEL**
Indicator: Plants and animal species and communities Measure: Number of native species that are listed as T&E, candidate, or of concern	2	3	3	1	9	HIGH
Indicator: Plants and animal species and communities Measure: Number of extirpated native wildlife species	2	2	3	1	8	MEDIUM
Indicator: Plants and animal species and communities Measure: Number of non-invasive non-native species	2	2	1	0	5	LOW
Indicator: Plants and animal species and communities Measure: Number of invasive non-native species	2	3	1	1	7	MEDIUM

Indicator: Plants and animal species and communities Measure: Number of acres of authorized active grazing allotments and number of AUMs of actual use	1	1			2	LOW
Indicator: Plants and animal species and communities Measure: Change in demography or composition of communities	2	2	2	0	6	MEDIUM
Indicator: Plants and animal species and communities Measure: Breeding land bird survey	1	1			2	LOW
Indicator: Plants and animal species and communities Measure: Vernal pool habitat quality	2	2	3	1	8	MEDIUM
Indicator: Physical resources Measure: Visibility based on average deciview and sum of anthropogenic fine nitrate and sulfate	Monitored at the National level					HIGH
Indicator: Physical resources Measure: Ozone air pollution based on concentration of N100 episodic and W126 chronic ozone exposure affecting sensitive plants	Monitored at the National level					HIGH
Indicator: Physical resources Measure: Acid deposition based on concentration of sulfur and nitrogen in wet 3deposition	Monitored at the National level					HIGH
Indicator: Physical resources Measure: Extent and magnitude of change in water quality	1	2	1	0	4	LOW
Indicator: Physical resources Measure: Extent and magnitude of human-caused stream bank erosion	1	1			2	LOW
Indicator: Physical resources Measure: Extent and magnitude of disturbance or loss of soil or soil crusts	1	1			2	LOW

Indicator: Biophysical processes Measure: Departure from natural fire regimes averaged over the wilderness	3	2	2	1	8	MEDIUM
Indicator: Biophysical processes Measure: Extent and magnitude of global climate change	2	3	2	0	7	MEDIUM
Indicator: Biophysical processes Measure: Area and magnitude for pathways for movement of non-indigenous species into the wilderness	2	2	2	1	7	MEDIUM
Indicator: Biophysical processes Measure: Area and magnitude of loss of connectivity with the surrounding landscape	1	1			2	LOW

UNDEVELOPED QUALITY: Criteria for Prioritizing Potential Measures						
Potential Measure	**A. Importance**	**B. Vulnerability**	**C. Reliability**	**D. Reasonableness**	**OVERALL SCORE**	**PRIORITY LEVEL**
Indicator: Non-recreational structures, installations, and developments Measure: Index of authorized physical development	3	2	3	1	9	HIGH
Indicator: Non-recreational structures, installations, and developments Measure: Index of unauthorized (user-created) physical developments	1	1				LOW
Indicator: Non-recreational structures, installations, and developments Measure: Number of structures (i.e., culverts) removed from wilderness	3	2	3	1	9	HIGH
Indicator: Inholdings Measure: Area and existing or potential impact of inholdings within wilderness	3	2	3	1	9	HIGH
Indicator: Use of motor vehicles, motorized equipment, or mechanical transport Measure: Type and amount of administrative and non-emergency use of motor vehicles, motorized equipment, or mechanical transport	1	1			2	LOW

Indicator: Use of motor vehicles, motorized equipment, or mechanical transport Measure: Type and amount of emergency use of motor vehicles, motorized equipment, or mechanical transport	3	3	3	1	10	HIGH
Indicator: Use of motor vehicles, motorized equipment, or mechanical transport Measure: Type and amount of motor vehicle, motorized equipment, or mechanical transport use not authorized by Federal land manager	3	2	2	1	8	MEDIUM
Indicator: Loss of statutorily protected cultural resources Measure: Number and severity of disturbances to cultural resources	3	1	3	1	8	MEDIUM

OPPORTUNITIES FOR SOLITUDE OR PRIMITIVE AND UNCONFINED TYPE OF RECREATION QUALITY : Criteria for Prioritizing Potential Measures						
Potential Measure	**A. Importance**	**B. Vulnerability**	**C. Reliability**	**D. Reasonableness**	**OVERALL SCORE**	**PRIORITY LEVEL**
Indicator: Remoteness from sights and sounds of people inside the wilderness Measure: Amount of visitor use	2	2	2	1	7	MEDIUM
Indicator: Remoteness from sights and sounds of people inside the wilderness Measure: Number of trail contacts	2	2	2	1	7	MEDIUM
Indicator: Remoteness from sights and sounds of people inside the wilderness Measure: Number and condition of authorized campsites	1	2	2	0	5	LOW

Indicator: Remoteness from sights and sounds of people inside the wilderness Measure: Area of wilderness affected by access or travel routes that are inside the wilderness	3	2	3	1	9	HIGH
Indicator: Remoteness from occupied and modified areas outside the wilderness Measure: Area of wilderness affected by access or travel routes that are adjacent to the wilderness	2	2	3	1	8	MEDIUM
Indicator: Remoteness from occupied and modified areas outside the wilderness Measure: Night sky visibility averaged over the wilderness	1	3	2	0	6	MEDIUM
Indicator: Remoteness from occupied and modified areas outside the wilderness Measure: Extent and magnitude of intrusions on natural soundsccape	3	2	1	0	6	MEDIUM
Indicator: Facilities that decrease self-reliant recreation Measure: Type and number of agency-provided recreation facilities	2	1	3	1	7	MEDIUM
Indicator: Facilities that decrease self-reliant recreation Measure: Type and number of user-created recreation facilities	1	1				LOW
Indicator: Facilities that decrease self-reliant recreation Measure: Miles of agency-provided trails	3	2	3	1	9	HIGH
Indicator: Management restrictions on visitor behavior Measure: Type and extent of management restrictions	3	2	3	1	9	HIGH

APPENDIX B- Effort Required for Wilderness Character Monitoring

Tables completed by: Monica Patel, FWS Wilderness Fellow

Effort per Measure:

Quality	Indicator	Measure	Were data gathered from office paper files, computer files, or field work (professional judgment is an option)?	Time you spent gathering data for each measure (in whole hours)	Comments
Untrammeled	Authorized actions	[1-1] Number of actions to manipulate plant, wildlife, insects, fish, pathogens, soil, water, or fire	professional knowledge	2	These actions are not formally documented in a central database. This is based on Refuge staff knowledge of activities within wilderness. There are relatively few activities done within wilderness and therefore consulting staff is best approach to gather this data.
Untrammeled	Authorized actions	[1-2] Number of natural fire starts that received a suppression response within wilderness	professional knowledge	1	Fire Management Specialist at Moosehorn NWR is knowledgeable of any fire activity on the Refuge, including Wilderness Area. There are formal reports of any natural fire starts and actions, if any, taken to suppress the fire.
Untrammeled	Authorized actions	[1-3] Number of lakes and other water bodies stocked with fish	professional knowledge	1	Refuge has not stocked fish any lakes or other water bodies within wilderness. Refuge Biologist would be appropriate source knowledgeable of any stocking activities within wilderness. There is no formal database. It does work in cooperation with the State of Maine in the stocking of Atlantic salmon, but physical stocking occurs outside of the wilderness boundary.

Untrammeled	Authorized actions	[1-4] Number of person-hours spent maintaining trail	paper files	2	Most of the trail maintenance is done by volunteer groups, such as American Hiking Society. Volunteer hours spent maintaining trails is recorded. The records include wilderness and non-wilderness trails and therefore require an additional tally to calculate total person-hours within wilderness. Wildlife Biologist keeps track of the volunteer hours.
Untrammeled	Authorized actions	[1-5] Number of person-hours spent treating invasive plant species	paper files	2	Most of the treatment and/or removal of invasive plant species is done by SCA interns during the summer. Person-hours are recorded. The records include wilderness and non-wilderness trails and therefore require an additional tally to calculate total person-hours within wilderness. Wildlife Biologist keeps track of these hours.
Untrammeled	Unauthorized actions	[1-6] Number of unauthorized actions to manipulate plant, wildlife, insects, fish, pathogens, soil, water, or fire	professional knowledge	1	These actions are not formally documented in a central database. This is based on Refuge staff knowledge of activities within wilderness. There are relatively few activities done within wilderness and therefore consulting staff is best approach to gather this data.
Natural	Plant and animal species	[2-1] Number of native wildlife species that are listed as endangered, threatened, candidate, or of special concern	Agency websites; professional judgment	Agency websites (2); professional judgment (1)	Agency websites provided species listed as endangered, threatened, candidate, or of concern. Professional
Natural	Plant and animal species	[2-2] Number of extirpated indigenous wildlife species	Resource books; professional knowledge	Resource books (3); professional knowledge (1)	This based on resources published by authors who have done research in identifying indigenous species of the area.
Natural	Plant and animal species	[2-3] Number of invasive non-native species	professional knowledge	2	There are no significant invasive non-native species in wilderness currently. This may change in the future.

Natural	Plant and animal species	[2-4] Vernal pool quality	computer files	1	Field work to count egg masses in specific vernal pool habitats were done twice during the Spring. Tallies were recorded and reported to Wildlife Biologist
Natural	Physical resources	[2-5] Visibility based on average deciview and sum of anthropogenic fine nitrate and sulfate	TBD		Monitored at the national level
Natural	Physical resources	[2-6] Ozone air pollution based on concentration of N100 episodic and W126 chronic ozone exposure affecting sensitive plants	TBD		Monitored at the national level
Natural	Physical resources	[2-7] Acid deposition based on concentration of sulfur and nitrogen in wet deposition	TBD		Monitored at the national level
Natural	Biophysical processes	[2-8] Area and magnitude for pathways for movement of non-native species into the wilderness	computer GIS files	3	Trails and Bearce Lake are identified as the two pathways that have the greatest potential to introduce non-native species into wilderness. Bearce Lake is identified because this is the only water body utilized by non-local visitors, which may bring in non-native species from other areas.
Natural	Biophysical processes	[2-9] Departure from natural fire regimes averaged over the wilderness	professional judgment	4	Because there is so little known about the natural fire regime in this area, the best approach is to consult with Regional Fire Planner and Fire Management Specialist.
Undeveloped	Non-recreational structures, installations, and developments	[3-1] Number of authorized physical development	professional knowledge	3	There is no central database documenting these authorized physical developments at this point. This is based on professional knowledge of the area.

Undeveloped	Non-recreational structures, installations, and developments	[3-2] Number of culverts removed	paper files	1	Since there is no complete inventory of culverts within the Wilderness boundary (or the Refuge in general), this measure aims to monitor culverts removed.
Undeveloped	Inholdings	[3-3] Number of inholdings within wilderness	paper files	1	There are no current inholding properties within the Wilderness boundary.
Undeveloped	Use of motorized vehicles, motorized equipment, or mechanical transport	[3-4] Type and amount of emergency use of motor vehicles, motorized equipment, or mechanical transport	computer files	1	Emergency uses are documented and reported to the Refuge. The Minimum Requirement Decision Analysis tool is utilized to identify the minimum tool and guide proper response within the wilderness.
Undeveloped	Use of motorized vehicles, motorized equipment, or mechanical transport	[3-5] Type and amount of motor vehicles, motorized equipment, or mechanical transport use not authorized by FWS	computer files	1	Majority of the unauthorized uses that are identified and reported to the Refuge and documented in an Incidence Report. Law Enforcement Officer may also be knowledgeable of any unauthorized uses that were not given citations but noted.
Undeveloped	Loss of cultural resources	[3-6] Number and severity of disturbances to cultural resources	professional knowledge	1	There are no known cultural resources within wilderness at this time.
Solitude +	Remoteness from inside	[4-1] Amount of visitor use during peak season	paper files; professional judgment	Paper files (2); Professional judgment (2)	This measure is based on trail counters, sign-in sheets, and professional judgment.
Solitude +	Remoteness from inside	[4-2] Number of trail contacts during peak season	computer files	0	This has not been done for the wilderness trails in 2011, but will be implemented next year
Solitude +	Remoteness from inside	[4-3] Area of wilderness affected by access or travel routes that are inside the wilderness	computer GIS files	3	This is based on trails within wilderness.

Solitude +	Remoteness from outside	[4-4] Area of wilderness affected by access or travel routes that are adjacent to the wilderness	computer GIS files	4	This is based on paved and unpaved roads adjacent to the wilderness that have or may have a potential impact on solitude.
Solitude +	Facilities that decrease self-reliant recreation	[4-5] Type and number of agency-provided recreation facilities	professional knowledge	2	This is based on known agency-provided recreation facilities. There is potential to gather additional information from SCA Trail Crew (i.e. number of signs)
Solitude +	Facilities that decrease self-reliant recreation	[4-6] Miles of agency-provided trails	computer GIS files	2	This is based on GIS data layer of existing trails within wilderness.
Solitude +	Mgmt restrictions on visitor behavior	[4-7] Number and extent of management restrictions	professional knowledge	1	This is based on Refuge regulations.

Refuge Effort:

Title of staff involved in identifying, prioritizing, and selecting measures	Staff time to identify, prioritize, and select measures (in whole hrs)	Comments
Refuge Manager	10	Extensive knowledge of the refuge
Wildlife Biologist, Maurice Mills	15	Extensive knowledge of the refuge
Supervisory Biologist, Ray Brown	3	
Law Enforcement Officer, Amanda Hardaswick	1	Relatively new at the refuge
Forester, Mike Heath	4	Relatively new at the refuge
Assistant Refuge Manager, Steve Agius	3	

Wilderness Fellow Effort:

Time you spent to identify, prioritize, and select all the measures (in whole hours)	Time you spent to learn how to enter data into the WCM database application (in whole hours)	Time you spent to enter all data into the WCM database application (in whole hours)	Time you spent on other tasks directly related to WCM (e.g., reading CCP, giving presentations, talking with staff) (in whole hours)	Time you spent doing <u>other</u> Refuge tasks not directly related to WCM (in whole hours)
120	3	24	80	32

APPENDIX C- Detailed description of data sources and data collection process

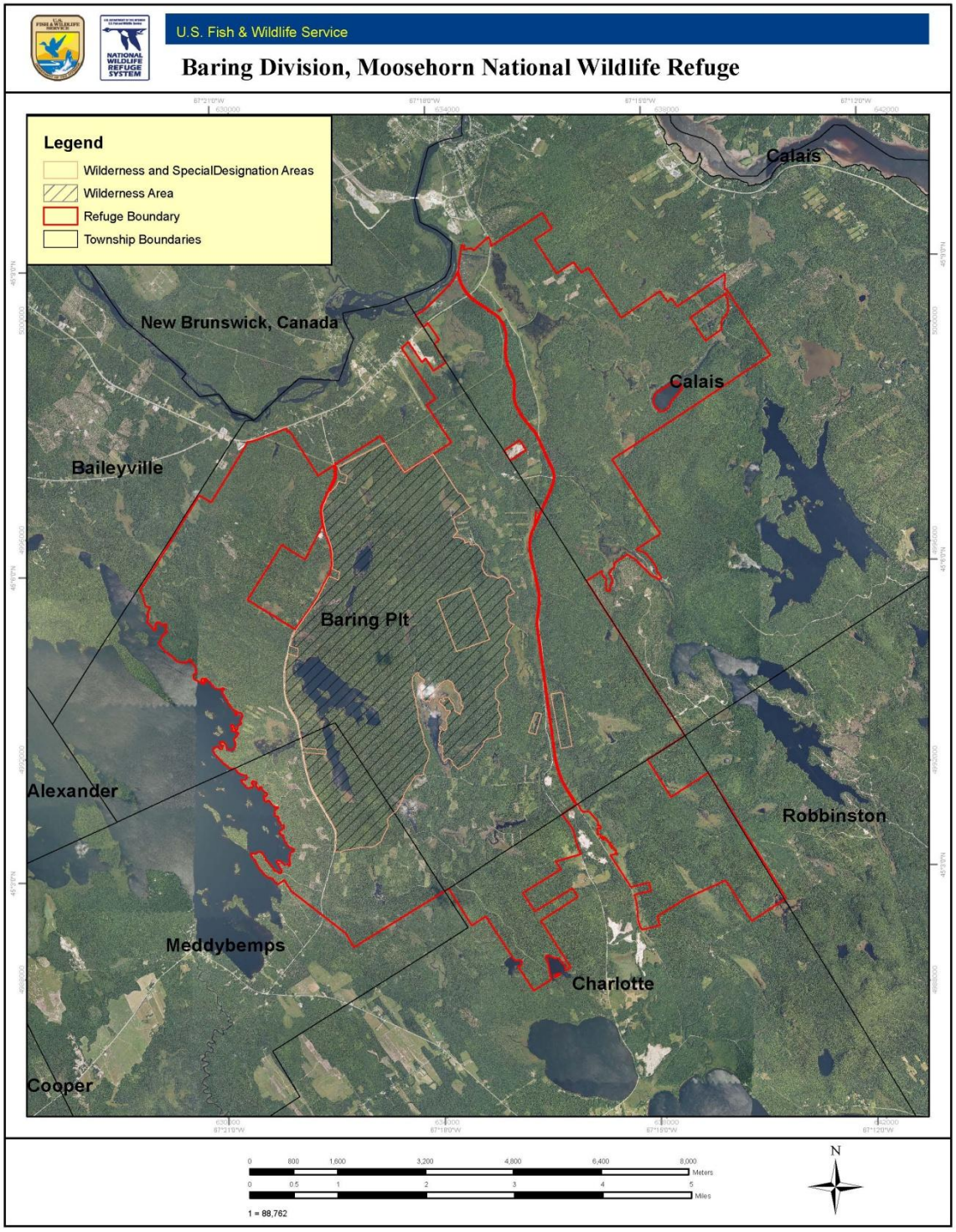
Measure	Priority (H, M, L)	Detailed Description of the Data Source(s) and How the Data Were Gathered
Untrammeled Quality		
[1-1] Number of actions to manipulate plant, wildlife, insects, fish, pathogens, soil, water, or fire	**M**	*Source:* Staff knowledge: Refuge Manager; Refuge Biologist; Biological Science Technician(s). There is no central database with this information at this time. *Process:* Consulted Refuge staff on any type of action(s) that manipulate the biophysical environment. Each separate action is counted and tallied annually. [Single action, single location = 1 action; Multiple action, single location = multiple actions; Multiple action, multiple locations = multiple actions; Action in one fiscal year = 1 action; Action in multiple fiscal years = multiple actions]
[1-2] Number of natural fire starts that received a suppression response within wilderness	**M**	*Source*: Refuge Fire Management Specialist *Process*: Consulted Fire Mgt. Specialist for number of natural fire starts suppressed.
[1-3] Number of lakes and other water bodies stocked with fish	**M**	*Source*: Refuge Wildlife Biologist *Process*: Consulted Biologist for this number
[1-4] Number of person-hours maintaining trail	**H**	*Source*: Refuge Manager *Process*: Calculated the total person-hours based on the number of volunteers and number of hours spent maintaining trails. Most of the volunteers are from the American Hiking Society and come for a week annually to work on trails.
[1-5] Number of person-hours treating invasive plant species	**H**	*Source*: Refuge Manager; Refuge Wildlife Biologist *Process*: Calculated the total person-hours based on the number of SCA interns (or volunteers) and number of hours spent treating invasive non-native plant species.
[1-6] Number of unauthorized actions to manipulate plant, wildlife, insects, fish, pathogens, soil, water, or fire	**H**	*Source*: Law Enforcement Officer, Incident Reports and/or RAPP; Biologist *Process*: Each separate action is counted and tallied annually. [Single action, single location = 1 action; Multiple action, single location = multiple actions; Multiple action, multiple locations = multiple actions; Action in one fiscal year = 1 action; Action in multiple fiscal years = multiple actions]. This includes unauthorized species takings, species releases, and large-scale trash-dumping within wilderness. This does not include minor infractions such as littering, small-scale vandalism, or insignificant trespassing.

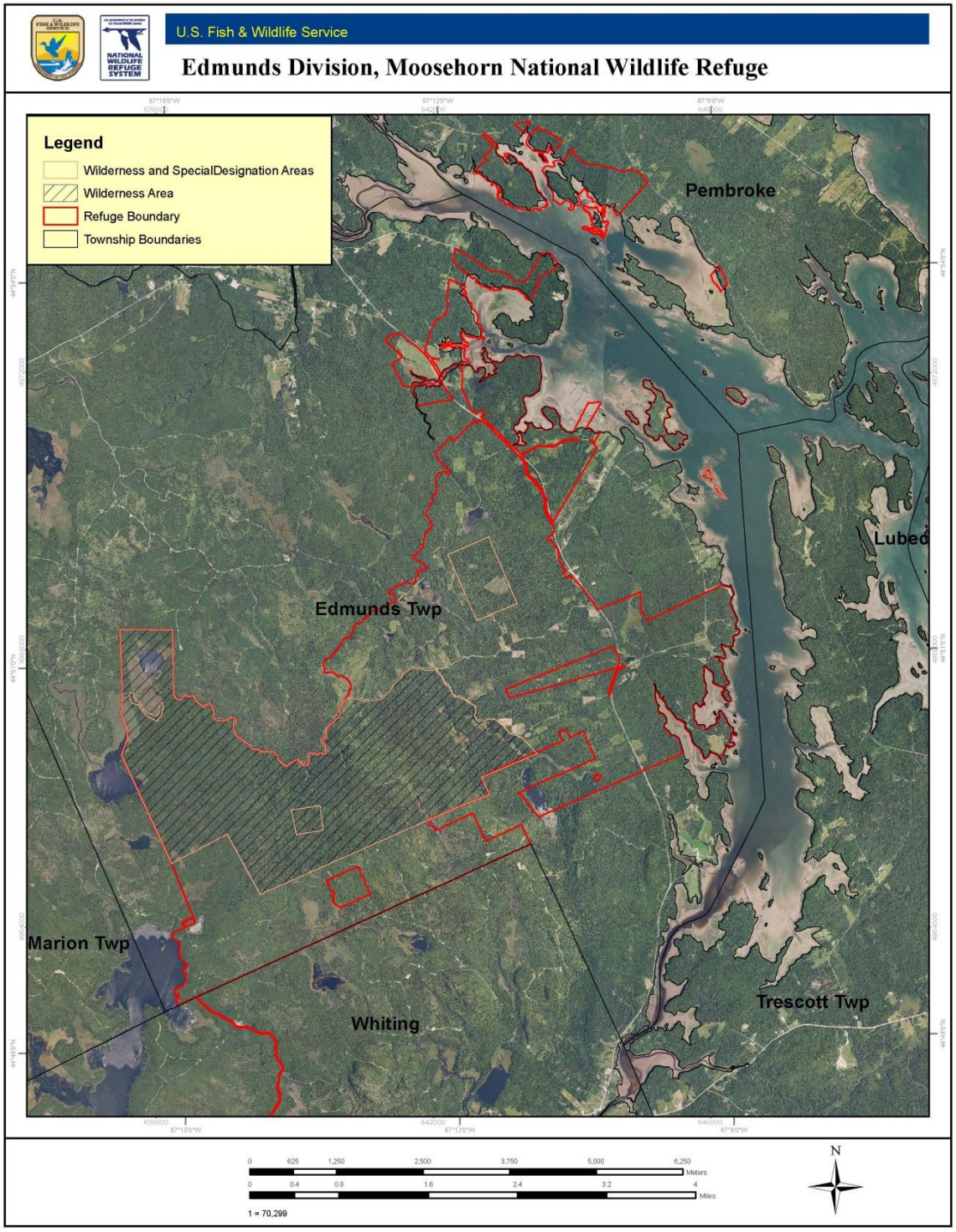
Natural Quality		
[2-1] Number of native wildlife species that are listed as endangered, threatened, candidate, or of special concern		*Source*: Maine Endangered and Threatened Fish and Wildlife Species List by the Department of Inland Fisheries and Wildlife; Maine's List of Endangered and Threatened Species (2007); Species Reports- Environmental Conservation Online System by the U.S. Fish and Wildlife Service; and Refuge Biologists and Andy Cutko (Maine Natural Areas Program) determined which were relevant for Moosehorn Wilderness. *Process*: Researched the website resources listed above and confirmed with Refuge Biologists for their professional knowledge of listed species for Wilderness Area. Each species is assigned a score according to its significance (i.e. Endangered = 4, Threatened = 3, Candidate = 2, and Special Concern = 1). Calculate the sum of all the scores. If the value of this measure changes, the local manager and resource specialist together will need to interpret if the change degrades or improves the natural quality.
[2-2] Number of extirpated indigenous wildlife species		*Source*: The Mammals of the Eastern United States (Whitaker and Hamilton); USGS Maine Cooperative Wildlife Unit (Bill Krohn). *Process*: Refuge Biologist researched extirpated species using above sources. Each extirpated indigenous species is counted once annually.
[2-3] Number of invasive non-native species		*Source*: Andy Cutko, Maine Natural Areas Program; Maurice Mills, Refuge Wildlife Biologist; Ray Brown, Supervisory Wildlife Biologist *Process*: Each invasive non-native plant species is counted once annually. Invasive non-native wildlife species are not present on the Refuge, including wilderness.
[2-4] Vernal pool quality		*Source*: Refuge Wildlife Biologist *Process*: Count the total number of egg masses for each indicator species (wood frog, blue-spotted salamander, and fairy shrimp) found in vernal pool habitat within wilderness each year. This will provide information on the abundance of these indicator species and in effect the health and quality of vernal pool habitat.
[2-5] Visibility based on average deciview and sum of anthropogenic fine nitrate and sulfate		*Source*: Monitored at the national level *Process*: TBD
[2-6] Ozone air pollution based on concentration of N100 episodic and W126 chronic ozone exposure affecting sensitive plants		*Source*: Monitored at the national level *Process*: TBD
[2-7] Acid deposition based on concentration of sulfur and nitrogen in wet deposition		*Source*: Monitored at the national level *Process*: TBD
[2-8] Area and magnitude for pathways for movement of non-native species into the wilderness		*Source*: GIS data folder *Process*: Using data layers for wilderness trails and Bearce Lake, created a ¼-mile buffer. The buffer was determined by Refuge Biologist as the area with the potential to introduce non-native species. The buffered area will be the area reported for this measure.

[2-9] Departure from natural fire regimes averaged over the wilderness		*Source*: Regional Fire Planner and Fire Management Specialist *Process*: Conducted conversations with Rick Vollick and John Meister to get professional judgment to estimate the departure from natural fire regime of the Wilderness Area. A scale (No departure = 0, Low departure = 1, Moderate departure = 2, and High departure = 3) was used to gauge the level of departure from natural fire regime based on their professional judgment and knowledge of the area.
Undeveloped Quality		
[3-1] Number of authorized physical development		*Source*: Refuge Manager; Refuge Wildlife Biologist *Process*: This measure is based on the collective knowledge of Refuge staff.
[3-2] Number of culverts removed		*Source*: Refuge Manager; Refuge Wildlife Biologist *Process*: Count each culvert removed every 5 years.
[3-3] Number of inholdings within wilderness		*Source*: Refuge Manager *Process*: Count the number of inholdings within wilderness every 5 years.
[3-4] Type and amount of administrative and non-emergency use of motor vehicles, motorized equipment, or mechanical transport		*Source*: Refuge Manager; Minimum Requirement Decision Guide records *Process*: This measure is the sum of the number of pieces of motor vehicles, motorized equipment and mechanical transport authorized times the relative weighting times the number of days authorized for each piece of equipment. A "low" level of impact is typically a mechanized use that causes a small impact to the social environment and little to no impact on the biophysical environment (i.e., hand held motorized equipment, battery power tool, or wheelbarrow). A "moderate" level of impact is typically a mechanized use that causes a relatively moderate impact to the social environment (i.e., air compressor, generator, or portable pump). A "high" level of impact is typically a mechanized use that causes a large impact to the social environment and biophysical environment (i.e., helicopter, truck, or heavy equipment).
[3-5] Type and amount of emergency use of motor vehicles, motorized equipment, or mechanical transport		*Source*: Refuge Manager; Law Enforcement Officer *Process*: This measure is the sum of the number of pieces of motor vehicles, motorized equipment and mechanical transport authorized times the relative weighting times the number of days utilized for each piece of equipment during the emergency. For the purpose of this protocol, each day of one incident is counted separately. A "low" level of impact is typically a mechanized use that causes a small impact to the social environment and little to no impact on the biophysical environment (i.e., hand held motorized equipment, battery power tool, or wheelbarrow). A "moderate" level of impact is typically a mechanized use that causes a relatively moderate impact to the social environment (i.e., air compressor, generator, or portable pump). A "high" level of impact is typically a mechanized use that causes a large impact to the social environment and biophysical environment (i.e., helicopter, truck, or heavy equipment).

[3-6] Type and amount of motor vehicles, motorized equipment, or mechanical transport use not authorized by FWS		*Source*: Refuge Manager; Refuge Biologists; Law Enforcement Officer *Process*: The use of unauthorized equipment by each of category (i.e. public, permittees, and agencies) of users is assigned a score, depending on its frequency (i.e. common, occasional, and none) of use multiplied by its areal extent (many locations, 1 or 2 locations, and none). The scores of each type of user are summed to generate a total score reported for this measure. [See Report on WCM]
[3-7] Number and severity of disturbances to cultural resources		*Source*: Refuge Manager *Process*: Count the number of disturbances to cultural resources
Solitude or Primitive and Unconfined Quality		
[4-1] Amount of visitor use during peak season		*Source*: Trail counter records (South Trail, Edmunds Division; Bearce Lake trailhead, Baring Division) and trailhead sign-in sheets (South Trail, Edmunds Division) *Process*: Utilized these records to estimate the amount of visitor use for wilderness. Due to the limitations of light trail counters (i.e. no differentiation between human or wildlife), the counts dramatically overestimate the actual visitor use. Sign-in sheets are also used to estimate the amount of people entering wilderness within one day; this is also inherent with limitations (i.e. not everyone signs the sheet). An estimation is calculated by the average number of people entering wilderness on a typical day based on the sign-in sheets. The average number is then multiplied by the total number of days from May-September to estimate the visitor use of Edmunds Division.
[4-2] Number of trail contacts during peak season		*Source*: Volunteers records the number of encounters and submit to Refuge Manager *Process*: This has not yet been implemented within wilderness, but will be next year. Volunteers will hike wilderness trails and count the number of people they encounter (i.e. following the same protocol as with other trails on the refuge).
[4-3] Area of wilderness affected by access or travel routes that are inside the wilderness		*Source*: GIS data folder *Process*: Using GIS, a ¼-mile buffer around access and travel routes is used to calculate the total area of wilderness affected.
[4-4] Area of wilderness affected by access or travel routes that are adjacent to the wilderness		*Source*: GIS data folder *Process*: GIS analysis will be used to compute the number of acres that are less than ¼ mile from any unpaved road or non-motorized ROW outside the wilderness; ½ mile from any paved road or motorized ROW outside the wilderness. This quality is degraded if the area affected by travel routes increases.
[4-5] Type and number of agency-provided recreation facilities		*Source*: Refuge Manager *Process*: Each of the following types of regulations is assigned a score, depending on its degree of restriction. If a wilderness has more than one type of regulation within a given category, the score will be assigned that corresponds to the most restrictive regulation in place. Tally up the management restrictions and associated score for this measure.
[4-6] Miles of agency-provided trails		*Source*: GIS *Process*: Measure the miles of system trails within wilderness

[4-7] Number and extent of management restrictions		*Source*: Refuge management policies *Process*: Each of the following types of regulations is assigned a score, depending on its degree of restriction. If a wilderness has more than one type of regulation within a given category, the score will be assigned that corresponds to the most restrictive regulation in place. Tally up the management restrictions and associated score for this measure.


U.S. Fish & Wildlife Service
Baring Division, Moosehorn National Wildlife Refuge
Legend
Wilderness and SpecialDesignation Areas
Wilderness Area
Refuge Boundary
Township Boundaries
New Brunswick, Canada
Calais
Calais
Baileyville
Baring Plt
Alexander
Robbinston
Meddybemps
Charlotte
Cooper
N
1 = 88,762


U.S. Fish & Wildlife Service
Edmunds Division, Moosehorn National Wildlife Refuge
Legend
Wilderness and SpecialDesignation Areas
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